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Cross pollination

Shaun Foster

Cross Pollination
By
Shaun Foster

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MFA Imaging Arts / Computer Animation
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MFA Thesis

Title of thesis: **Cross Pollination**

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Shaun Foster

January 12, 2002

Date

Table of Contents

Overview

This paper focuses primarily on the aesthetic development of my animated thesis project: "Cross Pollination." By necessity, the paper will come from a very analytical and intellectual perspective. While the actual aesthetic development of my thesis occurred in an organic and intuitive manner, for the purpose of this paper I will explicitly enumerate the influences and artistic developments.

Goal:

The goal of my thesis was a combination of factors. I wanted it to be a creative work where I could dream and use my imagination. I also wanted to incorporate some of my intellectual pursuits, which include reading about emerging technologies and hypothesized futures. Finally I wanted it to be visually beautiful and technically advanced.

Please note: The processes and technical solutions that were developed for this animation are discussed in a "Technical Notes" section in Appendix D.

Premise Behind the Story:

My story stems from the premise that, "Technology is in conflict with nature." But it is partially mitigated by my belief that as technology reaches higher levels in complexity it becomes more like nature in many ways. As this happens, the distinction between nature and technology blurs. Both nature and technology have Darwinian-evolutionary

qualities, however, their basic goals differ. The goal of technology is to function as a tool for humans. Technology is used to extend our abilities. This is clearly the case from the simplest technology (e.g. a fork, is an extension of the hand, which helps in the process of eating) to the most complex (e.g. a computer is an extension of our brains ability to store, process and access data). Differing from technology, nature's main goal is adaptive survival (reactionary). When nature is faced with a problem it adapts to fit-in and survive. It is ironic that humanity while part of nature, is at the same time one of the forces endangering its survival.

When technology and nature clash a consequence of nature's survival and adaptive qualities is that the results of the conflict are unpredictable. My hypothesis is that as technology becomes advanced to the point of near-sentience, it will begin to take on the survival and adaptive goals of nature. This will further compound the unexpected results that happen from a conflict between technology and nature.

Working on the Story:

Much of my pre-production work was trying to strengthen my story and design elements. My subject and basic plot were topical and fairly strong, however, some details of the story needed to be revised. I specifically chose Dr. Tina Lent as a thesis committee member because I felt she would be a great help in working on the details of the story. We met every other week for the first quarter and a half of the project, each week refining parts of the story. My initial story structure left all the conflict in the

middle of the film. Working with Tina and my other committee members, Howard Lester and Marla Schweppe, we came up with ways of adding tension and conflict visually and temporally (through my timing and editing). A great deal of time went into refining the treatment, especially the conclusion. My original story had a much more neutral ending with the spaceship flying away and the plant hiding seeds on the ship. The new ending is more dramatic and makes a much stronger, and slightly ironic, point. Once the story flow had been narrowed and refined, work began on how I wanted the characters to act and be perceived. How the robot probe would act took time to work out. What was its goal? I discussed with Howard the possibilities of having the goal be something besides the plant - for example, crystals. This would make the plant an inadvertent obstacle and was a very viable possibility because this happens quite often in modern life. For example, the Alaskan Wild Life Refuge sits on top of a potential gold mine of crude oil. However, I decided it would be easier to communicate if the conflict was kept directly between the robot and the plant. The story was already fairly complicated, and I felt it would be best to keep the goals and number of ideas as simple as possible. Originally the technology of the robot interfered less directly with the plant. It simply did this by blocking the plant's sunlight. I changed the robot's goal to extract ichor from the plant. This worked the best and streamlined my story and added a more direct and visual conflict.

The final struggle with the story treatment was to determine the delivery style. One choice that was considered was having a character-based film with highly

anthropomorphized characters. My final choice for the style and flow of the story was that of a visual poem which took root in its main focus stemming from the flower / plant. Linguistically, this made my piece "Antho" or plant focused ("Antho" is Greek for Plant) versus "Anthro" or human focus (from Greek Anthropos meaning man).

Research, Influences and Theory:

The topics integrated into the story are: robotics, nanotechnology (microscopic machines) and biotechnology, all of which are emerging technologies. Within limited time constraints I did research and continued to keep up with changes in developments of the technologies that were included in the story. One of the most influential and informative sources that went into the theory behind my story came from the article from the April 2000 Wired magazine "Does the future need us?" by Bill Joy (founder of Sun Microsystems). The article discussed the probable changes in our society (and possible extinction of humanity) as new technologies emerge that would eventually become more efficient and advanced than humanity. He states that humanity will change to an extent that our current society would find shocking. However, this process would be gradual and our society would be so inured that once we reach the brink of our own demise we would either not realize it, or would just accept a change of what our definition of human is now and simply adapt to the needed changes.

The 1964 book Understanding Media by Marshal McLuhan, includes a framework for understanding technology. His ideas were a great influence in the construction of the

theoretical bulwark of my thesis. The most evident influence from his book on my ideas was his discussions of how technology extends human abilities while conversely distancing humanity from itself and nature.

I also read several science fiction books that opened my eyes to the possibilities of the evolving technologies. The Diamond Age by Neil Stevenson dealt with nanotechnology, Beggars in Spain (Nancy Kress) and Jurassic Park (Michael Chrichton) illustrated possible changes in biotechnology. I had previously read many of the books by Isaac Asimov dealing with robotics and artificial intelligence. The book The Diamond Age discusses a simple use for nanotechnology: Nanite-"disassemblers". These microscopic robots, could be designed to break-down materials at the atomic levels when they were no longer needed. This concept inspired my idea of having the rocket shell disassemble (melt) instead of opening a door in my film.

Keeping Current

The status of the emerging technologies has made huge leaps during the year I have worked on my thesis. While there are large amounts of new data and developments in the areas of nanotechnology, biotechnology and robotics I will only mention a few that I found most fascinating and that influenced my thesis.

A decade ago nanotechnology was still theoretical. Now actual machines are being constructed at the molecular level. In May 2000, a power source for the nanites was

being developed using the wound DNA strands as a type of spring. Initially nanotechnology applications will be limited, however, the possible uses for fully developed machines that work on the microscopic level are endless.

The drive of new technology into the miniature has resulted in biotechnology being one of the fastest growing technological fields. It is a very new and exciting scientific field that is extremely unregulated. The powerful potentials unleashed with new biotech make this branch of science one of the most dangerous forces unleashed since the development of nuclear power. Pills of all sorts are now available to cure sundry ailments as well as new genetically engineered crops and livestock. The downsides of this technology are starting to show like the tip of an iceberg. Already genetically modified corn for cattle have been accidentally mixed into foods for humans and caused illness. New research questions the safety of BGH (bovine growth hormone) used to increase milk production. More leaps will continue to be made in biotechnology in the foreseeable future. As the power of this relatively unregulated technology increases, so does the possibility for disaster.

The line between silicon-based computers and the organic is blurring. New research into organic based computers is being done. Robotics and AI (artificial intelligence) have had the least spotlight lately, however, increases in micro-processing power and new developments in neural networks are bringing AI and robotics closer to the point where a robot can act and learn for itself. One of the major tests for AI is the "Turing Test"

(Hamlet on the Holodeck, Murray), where a computer program can act like a human to the point where the human would not be able to tell the difference. One of the strange consequences of this is the existence of "chat 'bots" on the internet. These programs actually converse with human users. There have been cases where, without the human realizing, they have had conversations with "chat 'bot" programs (thereby passing the Turing test).

The last line of research I pursued was into chaos theory and fractals. A core concept behind these subjects is that natural or highly complicated systems can be translated into mathematical models. My research led me into the basics of fractal theory, the more basic underlying equations, fibonacci numbers (the golden rule) and some core theory elements of chaos theory. The concepts I learned from studying the theory behind fractals I included as part of the visual motifs; I also used some of the more basic mathematical models for creating some of the images by the use of L-Systems and procedurally generated textures (see technical section).

Looking into the future and contemplating the possibilities, I tried to incorporate as many of these elements and motifs into my thesis.

Story Analysis and Interpretation

The goal of the story was to deal with the conflict between nature and technology.

Using the theory that technology separates us (humanity) from our environment drew it to the extreme. The person in the spaceship is so advanced technologically that he can't or won't care go to the surface of the planet. The person in the ship pushes buttons and has technology take care of his every need. This complete separation from the natural comes at a cost (you can't "smell the roses" if you are on a spaceship thirty miles above the surface of a planet).

Ideas about Nature

Nature exists and changes, adapting itself in a Darwinian process to fit into its environment. The person in the story (represented by the arm) lives in a society that is totally regulated by technology. Like the character Des Esseintes in the nineteenth century novel Against Nature by Joris-Karl Huysmans, the character in my thesis lives in an environment totally isolated from nature. Technology has replaced any need for nature. In fact, in order to achieve its purpose of being able to successfully take care of humanity, the highest levels of technology in my story have become similar to nature. Technology does this by taking on some of nature's adaptive qualities. My theory, supported by the Bill Joy article "Does the Future Need Us?" is that when technology reaches this level of sophistication this is, ironically, the point where the potential exists for the human race to destroy itself. Humanity is a bridge between technology and nature. As nature and technology begin to directly relate to each other, humanity drops out of the equation. Humanity, however, becomes more and more reliant on technology stopping its own adaptation to nature beginning to only to adapt to technology. The

consequence is the relationship between humanity, technology, and nature switches. Technology becomes the bridge between nature and humanity. Technology becomes more and more complex, expanding past human understanding until it becomes adaptive and self-sustaining. In some ways this is already happening.

Contrasting Technology and Nature

Unerringly the quality of nature is that it adapts to nearly any circumstance and subverts the status quo to fit its needs. Technology by contrast has a finite ability to adapt. There are myriad examples of nature adapting and defeating technology in the past. Many antibiotic drugs (technology) are no longer effective against the natural bacteria that has adapted to the antibiotics. Weed killers that were once effective have only bred stronger weeds. As a rule technology invades the world of the natural. Nature modifies either itself or the offending technology in a way that it is no longer a threat or it actually becomes an aid to the further progress of nature. "That which does not kill me makes me stronger"

Friedrich Nietzsche, Author

I fit these concepts into my thesis story by having the technological constantly invade the natural. The invasion proceeds like a set of miniaturized Russian dolls: The big ship launches a probe at the planet. The probe launches a robot that invades the landscape. The robot invades the flower by drawing ichor from it with a needle. When the flower retaliates by spitting pollen the robot releases nanites which invade the very DNA of the

plant.

At the point where technology can invade no further is the time when nature wins. While the original plant dies, nature survives by combining with the nanotechnology and producing a hybrid. This synthesis is stronger and more adaptive than the original plant.

The failure of humanity that has become so reliant on technology is demonstrated when the virulent metal-eating pollen unexpectedly gets into the quarantine zone of the technological spaceship. The human on the spaceship is coated by corrosive spores. Unable to adapt to the spores or activate his technology fast enough, the human is destroyed. The end of the film shows the new techno-flower thriving.

Visual Themes:

I wanted my film to be a visual poem. The poem would, like a fractal, be self-referential (Zooming into a fractal picture simply creates a large picture which is a similar shape to the original, while also including the original). This idea was intentionally integrated in several ways. Morphing from the planet in the first scene to the flower seed served to metaphorically demonstrate that even the largest planet was contained within the smallest seed. To visually demonstrate the theory that as technology becomes more complex it begins to echo nature the machines and ships were designed to look somewhat organic. This also accomplished my goal of wanting the

technological elements in the film to visually echo the natural elements. I designed the large spaceship to look like an insect. The opening shot has the spaceship, like a large metallic bee, flying out of a flower looking nebula. The large spaceship not only looks but acts like a bee. It does this by the part it plays in long-range cross pollination with the flower. This created a "fractal" conflict - the big spaceship wants something the planet contains, the probe-rocket is against (or disturbs) the land by scorching it, the robot is against the flower and the nanites compete with the pollen creating a hybrid flower.

Aesthetic Visual Style

My desire was to create a beautiful and highly detailed world. This was accomplished by creating visual environments rich in color saturation and texture. Complex visual scenes can cause the problem of the "forest getting lost in the trees." A specific example of this problem was in the filming of the flower. After working to create detailed plant-like textures, it became obvious that they blended into the background. This was because the colors of the plant and the contrast to the background were very similar. Bringing the plant into the visual foreground by giving it rim lights, slightly reducing the saturation and also blurring the background fixed the problem.

Symbolism and Metaphor:

Flower imagery is used as the central motif of this piece. Foreshadowing the flower is the opening nebula which was created to look flower-like. Other flower shapes in the

piece are: the opening of the launch bay doors on the main ship, the monoliths that the rocket ship flies past and the robot (it has petals, a stem and a radar dish on the top). In the construction of the original flower a helical form was used for the stem.

In Greek/Roman, and many other mythologies governed by a pantheon of gods, the female principle or Mother is represented by the earth. The male principle or Father is represented by the sky or sun. I tried to echo these archetypes in my work by having the angular male imagery be invasive, aggressive and come from the sky. The female/natural objects were rounded in shape and were non-aggressive and reactionary.

"Cross Pollination" infers the creation of a third species, a robot/plant hybrid. There are many visual metaphors hinting at reproduction. Bees often represent conduits for reproduction. Literal bees and a bee like spaceship represent the natural and technological delivery systems for the reproduction.

Psychological (Freudian) Analysis

When Freud was asked by one of his students what the symbolic significance of his habit of smoking cigars was, he replied "Sometimes a cigar is just a cigar." While at times I integrated Freudian symbols consciously, the main desire and implementation of these symbols came from my unconscious. Historically, nature has been seen as feminine. To reflect this, most of the natural objects are rounded or have interior spaces. The metaphoric coding of the sexes is also emphasized by the use of color. The female is in

greens or yellows. The male is represented by cylindrical, pointy objects, that are analogous to the male phallus. The colors for the masculine are metallic grays and blues. The piece as a whole fits well into Freudian psychology: it deals with reproduction. Launching of the probe is like a sperm going toward an egg (the planet). A flower is often a symbol for the feminine. On the planet the "male" robot sticks the needle in the flower. This action triggers the end result of the cross pollination between technology and nature.

Math in Nature

The concept of the "fractal" has fascinated me, both philosophically and intellectually.

"Fractal" From PCWebopedia: www.pcwebopaedia.com/TERM/f/fractal.html is defined as:

> "A word coined by Benoit Mandelbrot in 1975 to describe shapes that are "self-similar" -- that is, shapes that look the same at different magnifications. To create a fractal, you start with a simple shape and duplicate it successively according to a set of fixed rules. Oddly enough, such a simple formula for creating shapes can produce very complex structures, some of which have a striking resemblance to objects that appear in the real world. For example, graphics designers use fractals to generate images of mountainous landscapes, coastlines, and flowers. In fact, many of the computer -generated images that appear in science fiction films utilize fractals. Fibonacci numbers and fractals. Botanists have shown that plants grow from a single tiny group of cells right at the tip of any growing plant called the meristem."

After exploring this concept and reading about the different places fractals were found in nature, I began to work the fractal concept into my piece. This was done in several ways. Many of the objects created from natural phenomena that were featured in my

thesis have relations to fractals, for example, the cellular structures, the root systems, and cloud formations. Not surprisingly, many of the programs and code I wrote to create these objects used the repeating algorithms of fractal math; Afterburn for cloud and smoke effects, Darktree Textures for procedural texture generation and Blur Studio's L-system plug-in. L-systems are a system of rules that are written into a program. I wrote my own repeating algorithms to create the root system, the flower base and leaves and DNA. The equation or rules I supplied to the L-system was to create the start of the object. Once the core (or first generation) was created I animated the repetitions calculated by the computer to "grow" geometry. For more specifics on L-Systems see the Technical Section.

Fibonacci sequences are repeating patterns in a sequence of numbers. Originally identified after an analysis of how rabbits could mate, this phenomenon has been identified in many other circumstances. The set describes a branching pattern found in logical paths nature can take. The pattern starts: 1, 1, 2, 3, 5, 8, 13, 21, 34, ... This illustrates a pattern: X + X2 = X3. X2+X3 = X4. e.g. = 1 + 1 = 2, 1+2 = 3, 2+3 = 5 etc. Bee mating often exhibits a fibonacci sequence, as do branching algorithms of plants. These patterns appear because they are the best, or most likely way evolved to a mathematical theorems in nature. Likewise the "Golden Section" or (also given the Greek letter Phi) has similar applications. The golden section refers to proportions, and also mathematically describes phenomenon in nature. I used the golden section proportions in designing certain objects in my film. Many of the components of the

robot were formed to match the "Golden Section."

Sound:

Sound was used both to flow with the visual complexity and richness of the piece and also create a dramatic contrast to it. This was done several times by switching to very minimalist use of sound. I played off the two, as well as using music and sound effects as counterpoint. Choosing to have rich sound effect environments for the technological while minimal sound effects and emphasis on the musical score for the natural scenes created a nice sound coding system for the different elements. I had several creative meetings with my composer Vicente Avella. We discussed the sound and music goals I had for my piece as well as my overall goals for what I was trying to express with my piece. His idea was to use male and female vocals to underscore the archetypal female-natural world, and male-technological dominated worlds. The two vocals come together as the plant is invaded by the microscopic nanites at the DNA level. Sound was also used in two other ways: I consciously used sound to soften some cuts. This was done by starting the sound a quarter second before the cut. The other was to create more "realism" varying sound levels based on location to the camera. As the camera got closer to an object that would emit sound, the sound effects in the score were upped in volume, likewise the inverse was done for an object moving away from the camera.

Editing:

My previous projects were very linear. When planning out the storyboard it seemed that

the animation, especially because it was a visual poem, could incorporate the Kuleshov principle (A + B association editing). This was done with the planet and the seed (the planet morphs into the seed). Also when the hybrid plant begins to grow I cut to the rocket "fleeing" the planet. Parallel editing was evident though out the piece. Match cuts were used by cutting between objects of similar shapes. Generally editing was used to create a flow and consistency, however, the opposite was done when the needle wielding robot attacked the flower. This cut was adjusted to be slightly jarring (almost a jump-cut) to emphasize the shock the flower felt as it was struck by the needle. Finally, editing was used with the timing of the music to help create a rhythm and visual flow to the piece.

Revisions

The revision process was very challenging. However, it was highly useful and ultimately rewarding. While the piece had been storyboarded and much visualization done beforehand, when I saw it compiled the first time, it was apparent there were some problems. There were several editing problems (jump cuts) and also the pacing and tempo of the whole piece wasn't quite right. It took another month and a half to make all the revisions and changes that were necessary.

Conclusion

The thesis project lasted a quarter longer than I had desired, however, I feel proud of the project. Not only do I feel this project is successful as a visual poem, but the project as a

culmination of my masters work at RIT articulates the development of aesthetic and technical skill that I worked hard to attain.

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Stevenson, Neil The Diamond Age. London: Bantam Books, 1996

Huysmans, Joris-Karl Against Nature (A rebours) Translated by Margaret Mauldon, Nicholas White ed. Oxford: University Press, 1998

Web Pages / Online Resources:

DNA From the Beginning
http://vector.cshl.org/dnaftb/

Honeybee Biology
http://koning.ecsu.ctstateu.edu/Plants_Human/bees/bees.html

Human Genome Project
http://www.ornl.gov/hgmis/graphics/slides/images2.html

Semi-Conductor Datasheets
http://www2.unl.ac.uk/~hxgzcamerog/DataSht.htm

The Tech Museum - Robotics
http://www.thetech.org/robotics/

Fibonacci Numbers and the Golden Section
http://www.mcs.surrey.ac.uk/Personal/R.Knott/Fibonacci/fib.html

L-System Plug-In for 3D max
www.Blur.com

Laurens Lapré's Website on L-Parser
http://www.xs4all.nl/~ljlapre/

C.J.van der Mark's L Parser Tutorial
http://www.xs4all.nl/~cvdmark/index.html

P. Prusinkiewicz's "Visual Models of Morphogenesis: A Guided Tour" (Chapter 8)
http://www.cpsc.ucalgary.ca/projects/bmv/vmm-deluxe/Section-08.html

The Molecular Structure Center
http://www.iumsc.indiana.edu/

Appendix A: Original Thesis Proposal

Proposal for an MFA Thesis Project

Irising

By

Shaun Foster

MFA Imaging Arts / Computer Animation
SCHOOL OF FILM AND ANIMATION
ROCHESTER INSTITUTE OF TECHNOLOGY
APRIL 2, 2000

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Treatment

Irising
By Shaun Foster

It is dawn in a clearing in a forest. The sun is just coming over the horizon, and there is a light mist on the ground. Birds are chirping and bees are buzzing nearby. On top of a grassy hill there is a blue and white iris. We go closer to the flower, it stretches and twists as it grows bigger, then the flower begins to open. Under the earth, the root system expands and extends.

A research star ship is in low orbit over a green and blue planet. Inside a gloved hand presses a button and probe is fired from a launch tube on the side of the ship. The probe flies toward the planet, it starts glowing red as it enters the atmosphere. It becomes a small meteor and its outer shell burns off. It crashes deep into the dirt next to the flower. It's landing cuts off part of the root system of the flower.

Spider like legs and antennae come out of the earth where the probe landed. Small satellite dishes swivel around, and solar panels extend. It looks like a distorted metallic flower. A light is bleeping on and off as it transmits data back to the mothership. It is blocking the sunlight from the flower. The flower sways back and forth, but can't reach the sunlight. Interested the probe swivels a camera aimed at the flower. The flower strains itself, growing taller, it grows a new bud which bursts releasing pollen. Some of the pollen covers the machine. The machine analyzes it, zooming in to an electron microscopic level. At the microscopic level the pollen attaches itself to the metal of the machine, corroding it. More pollen flies up to a tree where there is a bees nest. A panel on side of the machine opens up and releases a small flying machines which spray clouds of nanites (very small machines) which defend the machine from the pollen and begin to clean the it off. Bees fly out toward the flower and the machine. On the legs of the bees there are grains of pollen. The bees land on both the flower and the machine. At the molecular level the grains of pollen and the nanites come together altering the helical DNA. The plant and the machine entwine, struggling like climbing vines while a cloud of pollen and nanites hover over them both. The sky becomes overcast and it begins to rain. The machine rusts and like a faltering heart the blinking light stops and it ceases to bleep. The flower becomes brittle and tan as it dies. From between them grows a new flower, part metal and part plant. It grows to a huge height and forms a big flower bud. When the flower opens it spits giant prickly seeds high into the air. Where the seeds land they grow fields of the new flowers. One large seed flies into outer space. It drifts, and latches onto the hull of a different passing spaceship as it passes through the solar system.

Visual Development Ideas
I'm interested in investigating the line between chaotic (natural) systems and ordered technological ones. I'm hoping to explore this visually by doing this project as a 3D animation. I will be using Houdini to create organic trees and also possibly for some of the particle effects. Will be doing the main modeling with 3D Studio Max, and be using Dark Tree textures which are mathematically generated textures, and Afterburn for cloud effects.

udget

escription	Estimate Total Cost	In Kind	Actual
esearch	600	300	30
cript	1200	1200	5
toryboard	1200	1200	15
nimatic	1200	1200	0
haracter Design	1200	1200	0
D Background Modeling	5400	5400	0
ighting / Texturing	1800	1800	0
mage Compositing	1000	1000	0
D Animation	5400	5400	0
ound FX Gathering	2500	2000	15
oundtrack Composition	500	1500	50
oundtrack Recording	2000	1900	50
lardware	6000	0	0
dditional Hardware (graphics card)	700	0	700
oftware	6000	6000	250
ideotapes	35	0	35
D-Rs	30	0	30
ip / Jazz Disks	100	0	100
ostage to Festivals	50	0	50
hotocopying / Printing	50	20	30
otal	**$36,965.00**	**$30,120.00**	**$1,360.00**

Timeline

	Total Time	Est. Date Complete
Treatment	4 weeks	April 5, 2000
Story board	2 weeks	April 10, 2000
Proposal	1 week	April 10, 2000
Visual Research	2 weeks	April 25, 2000
Sound Research	3 weeks	May 1, 2000
Modeling	8 weeks	July / September 2000
Lighting / Texture work	3 weeks	September 11, 2000
Animation	8 weeks	January 15, 2001
Rendering	3 weeks	February
Post Production	6 weeks	March 19, 2001
Screening	1 Day	May 1, 2001
Thesis Paper	2 weeks	May 11, 2001

Marketing Plan

For Screening:
Plan on screening at the end of the quarter with the spring films. Will post fliers, e-mail friends and do a "word of mouth" advertising campaign.

Festivals
Plan to submit animation to the following eleven festivals:

1. Ottawa International Festival
2. Vancouver Effects and Animation Festival
3. Northhampton Film Festival
4. The Crested Butte Reel Festival
5. ASIFA East
6. SIGGRAPH
7. Movies on a Shoestring
8. Fort Worth Film Festival
9. Chicago Underground Film Festival
10. Cinematexas
11. IFFM

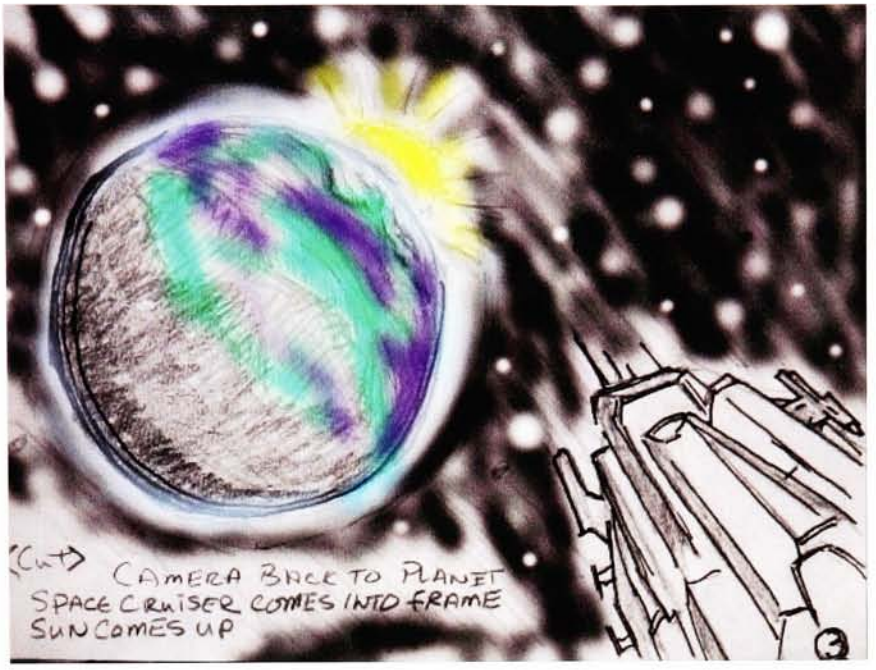
Story Summary (final version)

From a far away flower-like nebula a person in a spaceship detects a molecular substance that it decides to investigate. A plant grows on the surface of the planet, within it is the desired molecular substance. The spaceship launches a rocket-probe with a robot inside to retrieve a sample of the substance from the plant. Taking a sample of ichor from the plant causes the plant to spit pollen spores at the robot. The spores mix with, and begin to eat away at the metal of the robot. The robot releases red clouds of microscopic machines called nanites to deal with the pollen. The nanites spread over the area angering a hive of bees. The bees swarm over the robot and the flower. A random bee landing on the flower spreads nanites further going deep into the flower. The nanites enter the plant and combine with the flower on the DNA level. The flower dies from the nanite intrusion but produces a seed as the robot returns to the ship. The person on the ship looks at the test-tube of plant ichor. There is a crack in the test-tube and some of the spores escape, causing another spread of the aggressive metal-eating pollen-spore-infection. On the planet the new hybrid flower grows and a new flower opens. The spaceship covered with the pollen-spore infection explodes! The hybrid flower continues to flower and open as the piece ends.

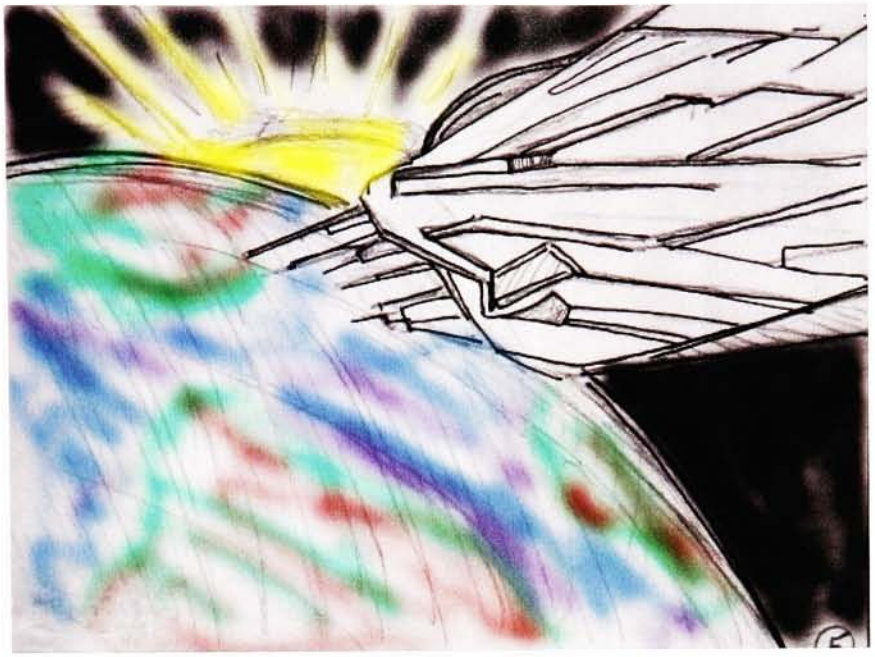
Appendix B: Original Storyboard

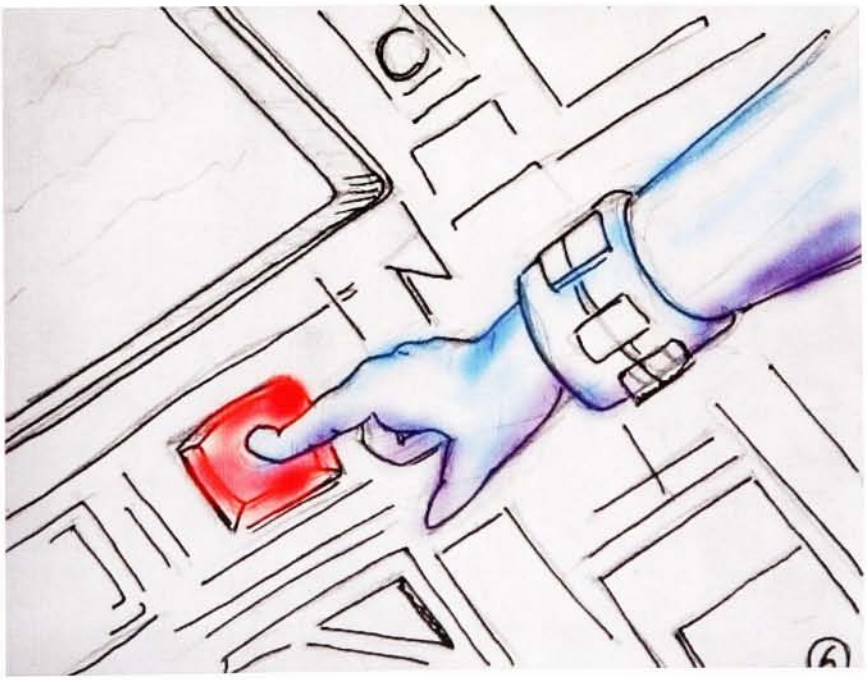
[STARY SKY-CAMERA PANS UP...
IN THE DISTANCE A SMALL PLANET] (1)

(SFX) CRICKETS - Night Sounds
- CUT TO UNDER THE SOIL; THERE ARE (2)
Rocks + flecks of mica, it is Dark Above Ground


(Cut) CAMERA BACK TO PLANET
SPACE CRUISER COMES INTO FRAME
SUN COMES UP
3


Plant GROWS-
SUN RISE
4

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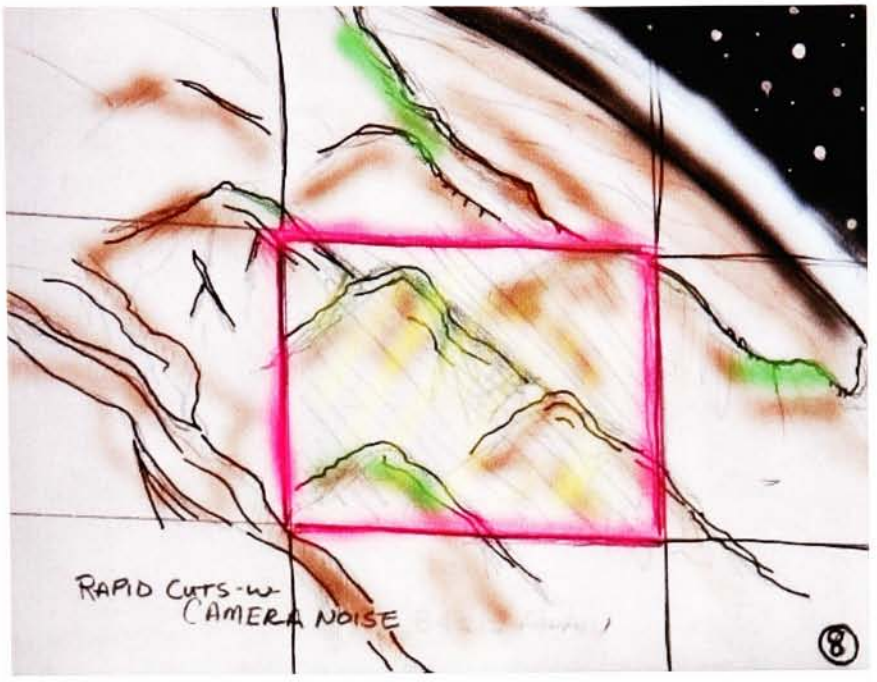
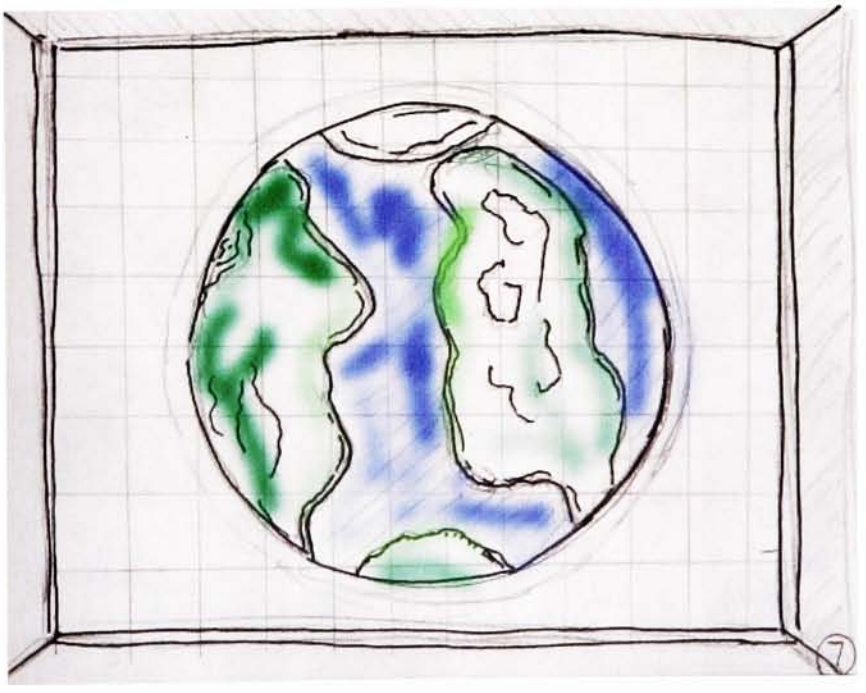
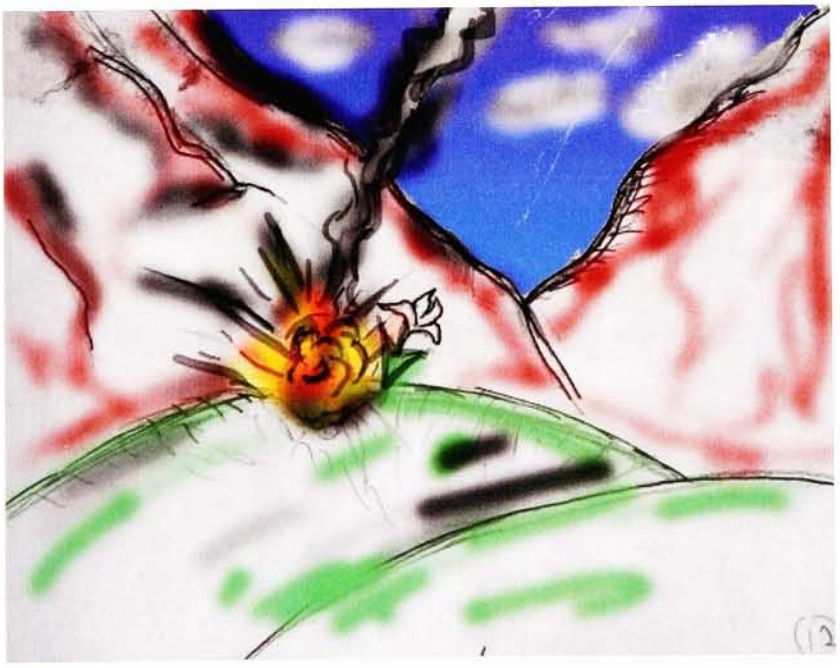
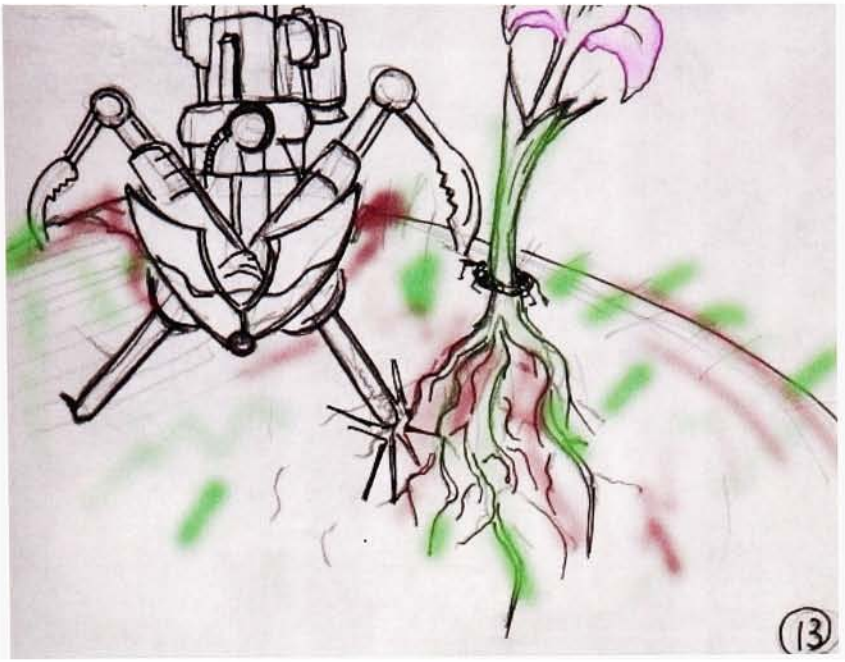

RAPID CUTS-W-
CAMERA NOISE
8

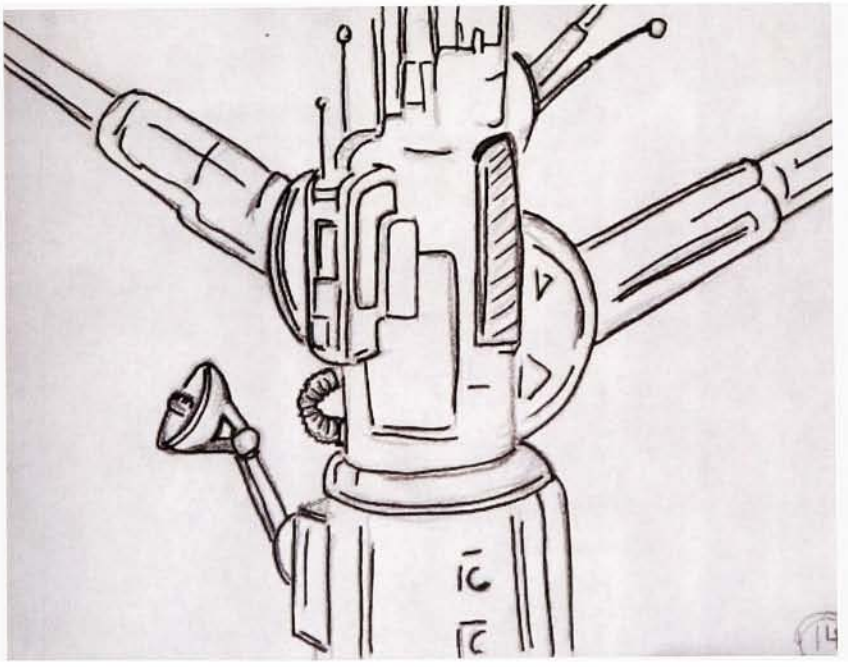

7

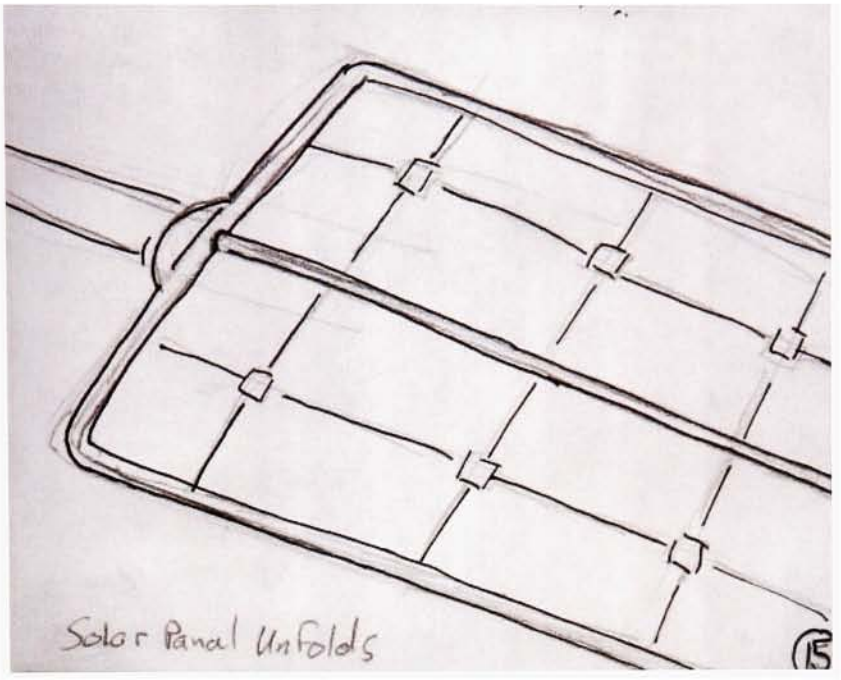

UNDERNEATH THE SPACESHIP


MAYBE W. BEE
10




13

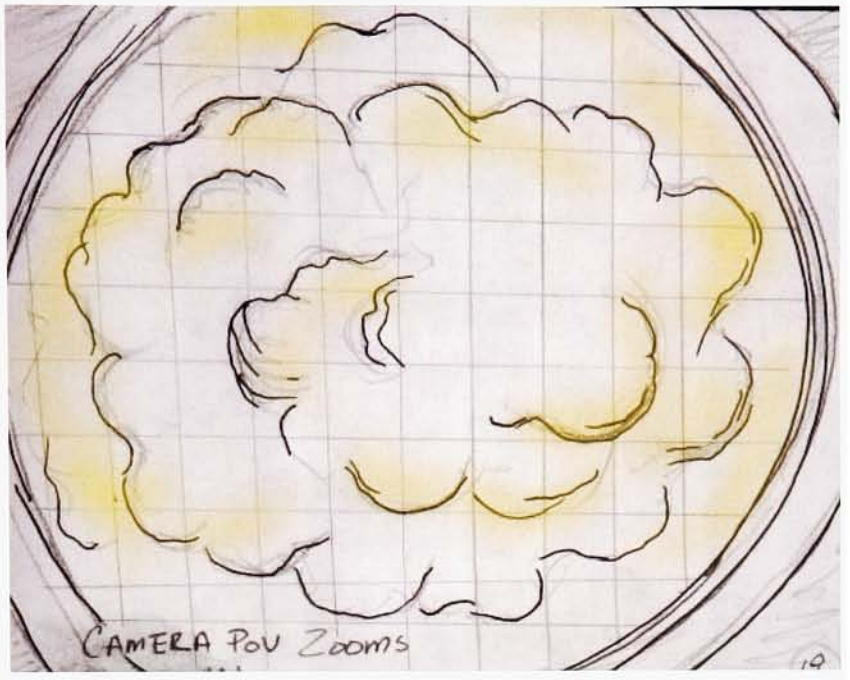


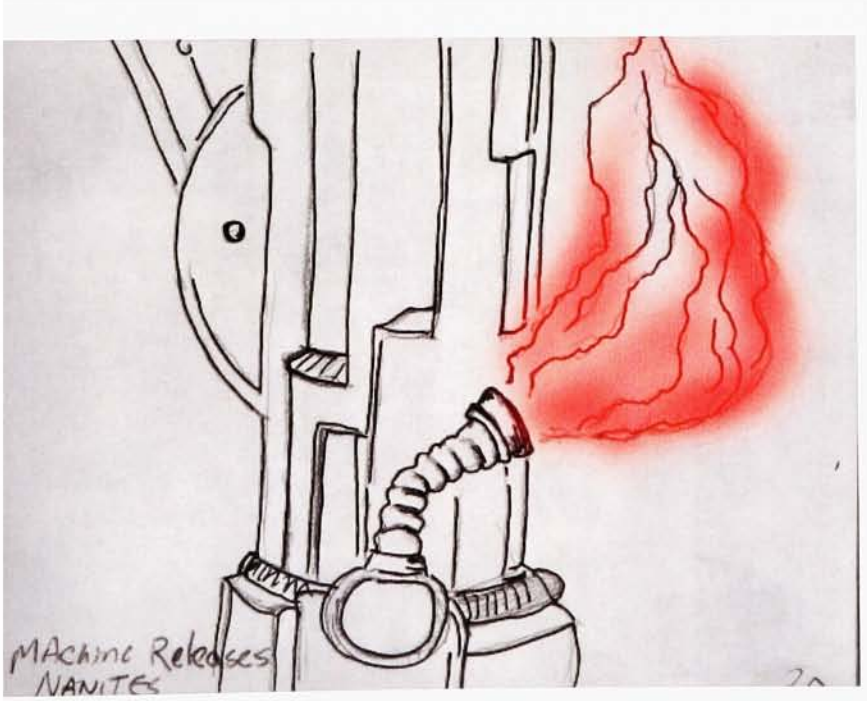

Solar Panal Unfolds
15

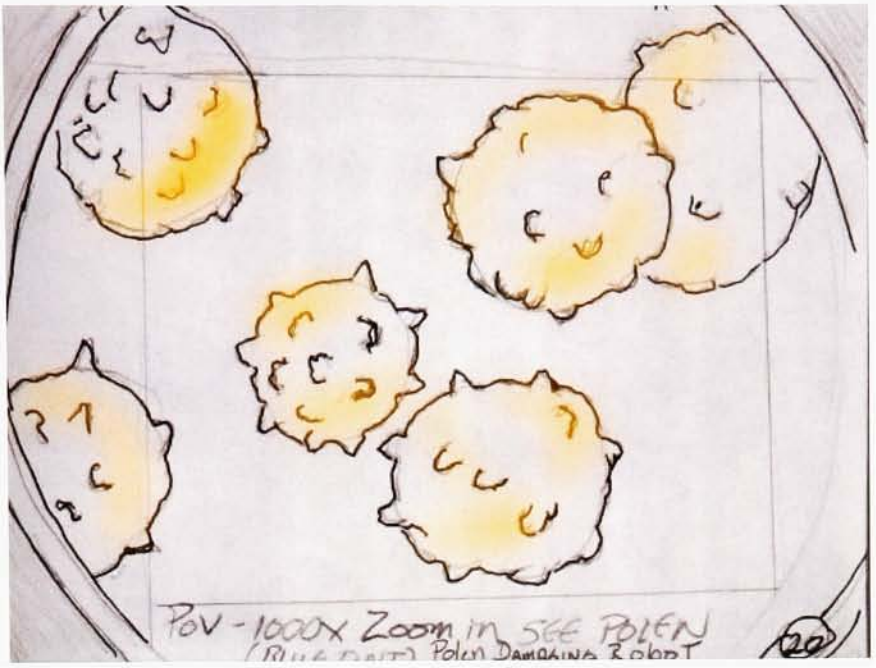

FLOWER IN SHADE tries to
MOVE AWAY BUT CANT


Plant grows another bud

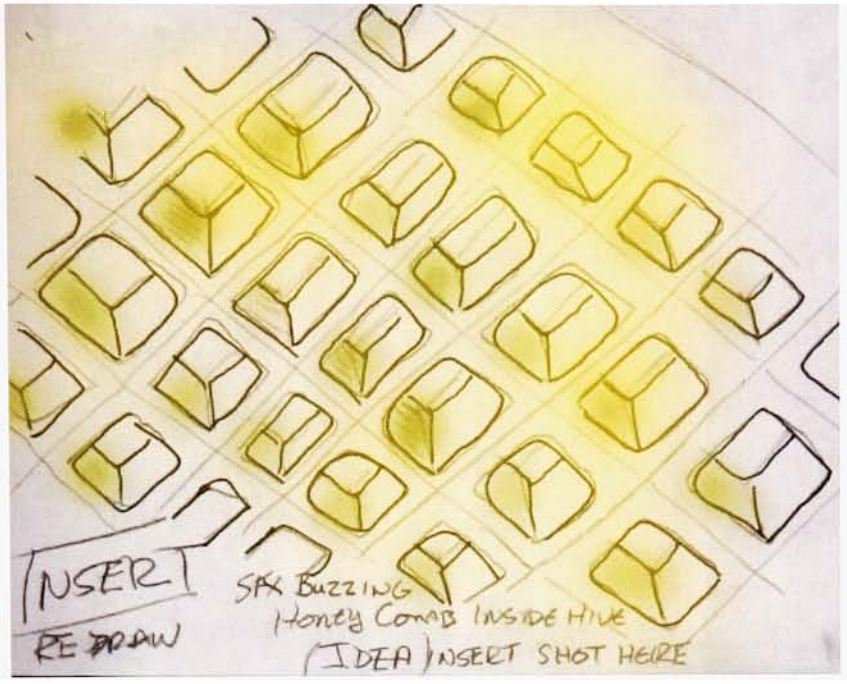

FLOWER SPITS SPORES/
POLEN
AT ROBOT


CAMERA POV Zooms
19


MAchine Releases
NANITES

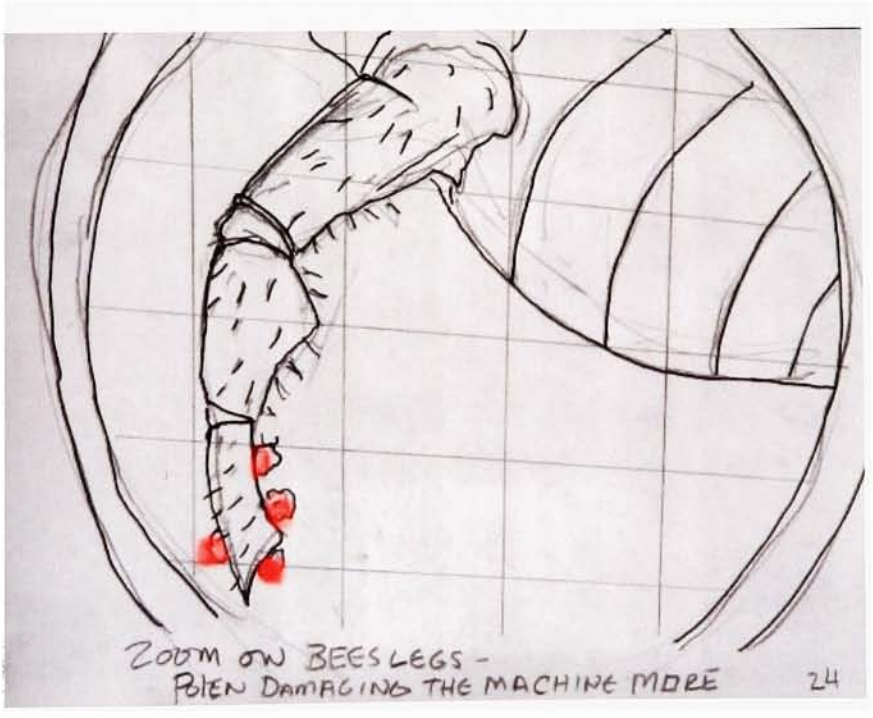

POV - 1000X Zoom in SEE POLEN
20

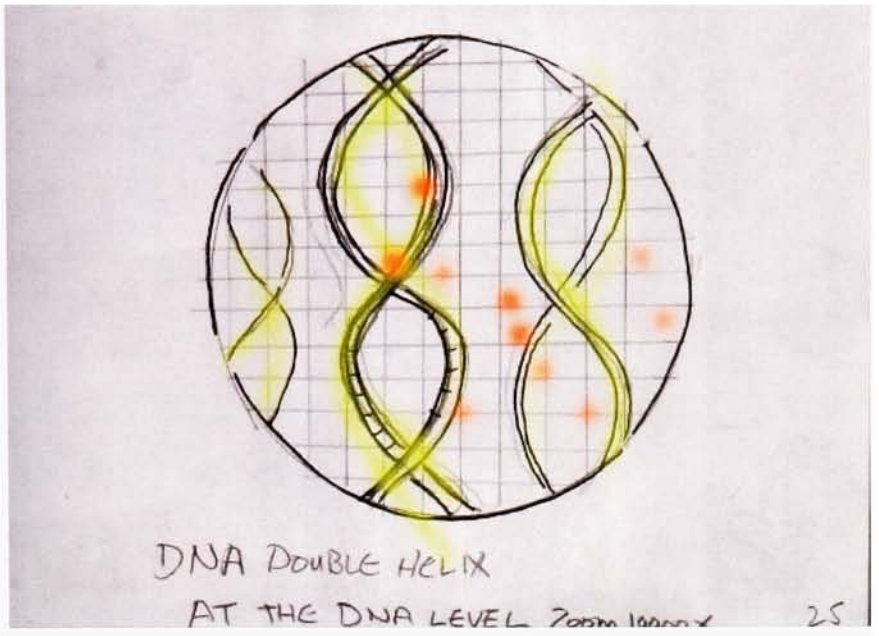

POV CAM 1000X Zoom
21


INSERT
RE DRAW
SFX BUZZING
Honey Comb INSIDE HIVE
(IDEA) INSERT SHOT HERE


<A BEEHIVE>
MEANWHILE...IN A NEARBY TREE
22

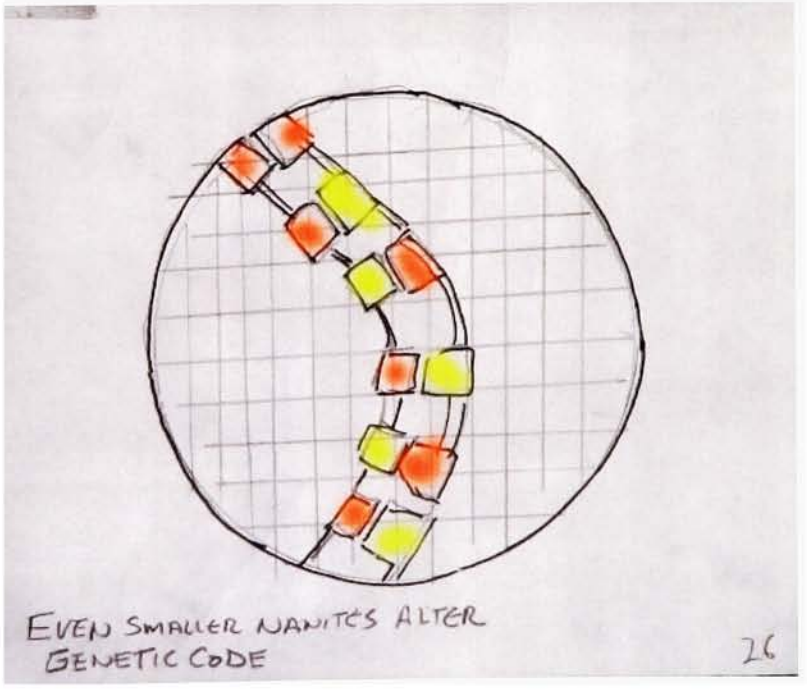

BEES SWARM PLANT + MACHINE
23


ZOOM ON BEES LEGS -
POLEN DAMAGING THE MACHINE MORE
24



DNA DOUBLE HELIX
AT THE DNA LEVEL ZOOM 1000000X

25

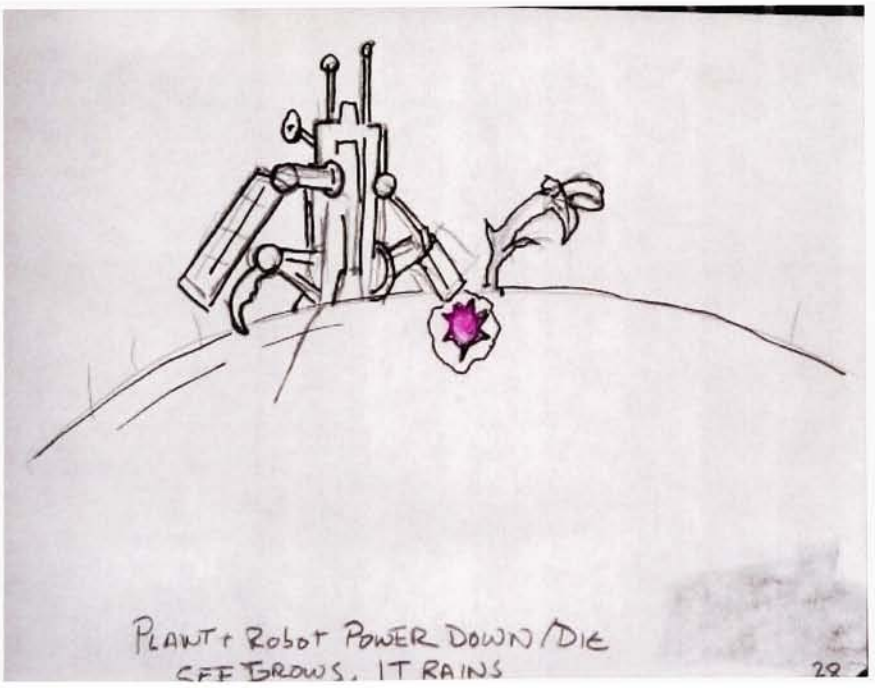


EVEN SMALLER NANITES ALTER
GENETIC CODE

26

THE PLANT PRODUCES A NEW SEED

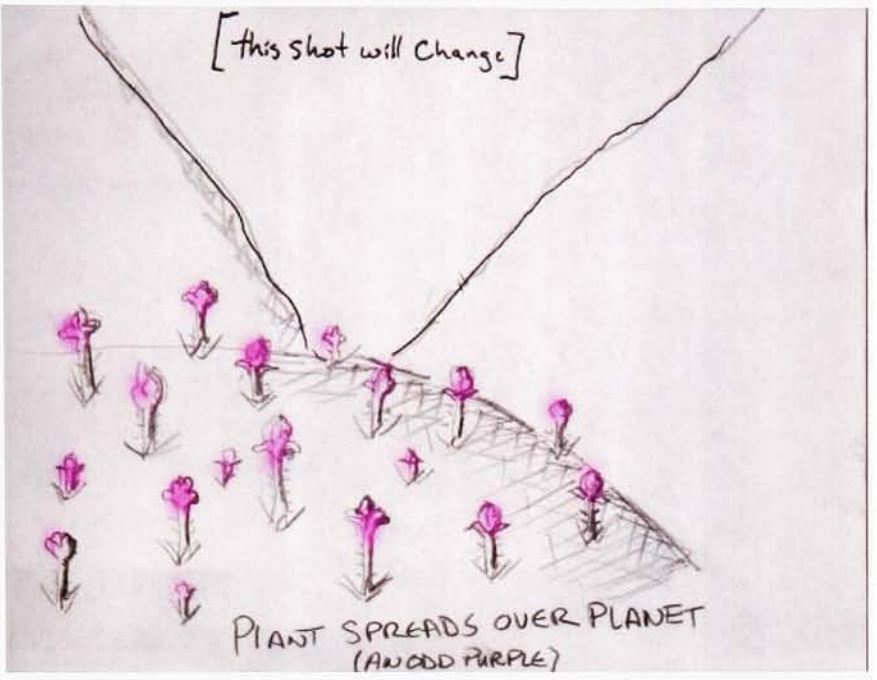
27



PLANT + ROBOT POWER DOWN / DIE

CUT GROWS. IT RAINS

28

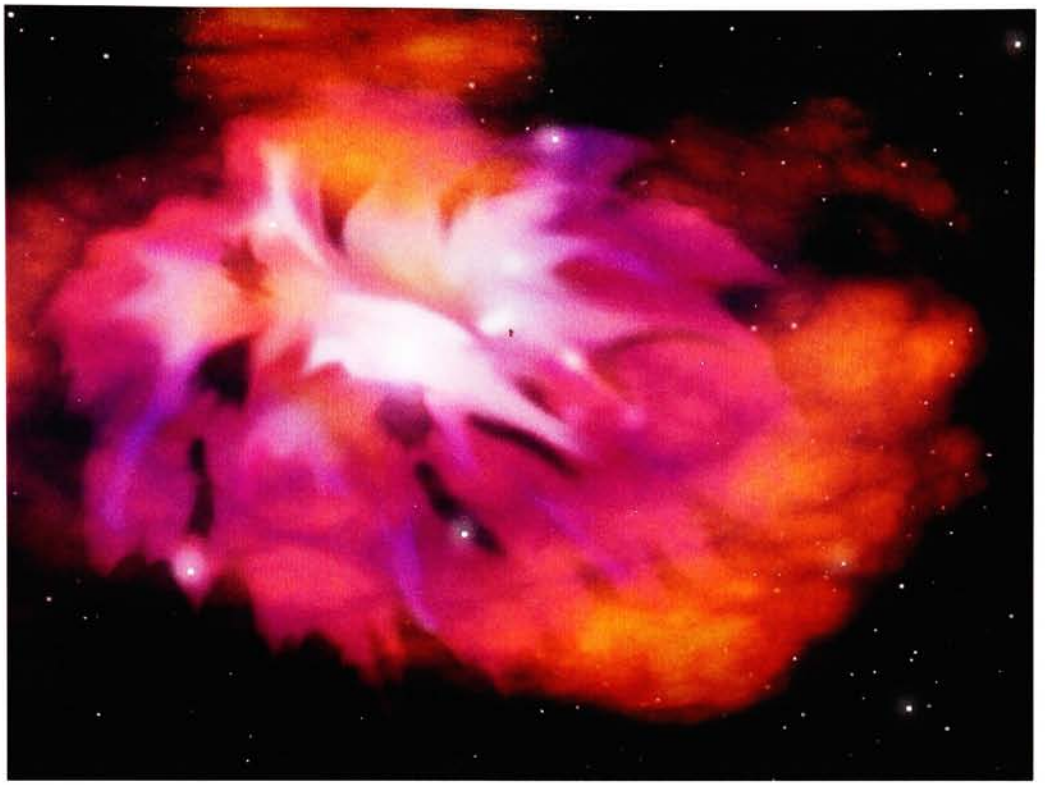

[this shot will Change]
PLANT SPREADS OVER PLANET
(AN ODD PURPLE)

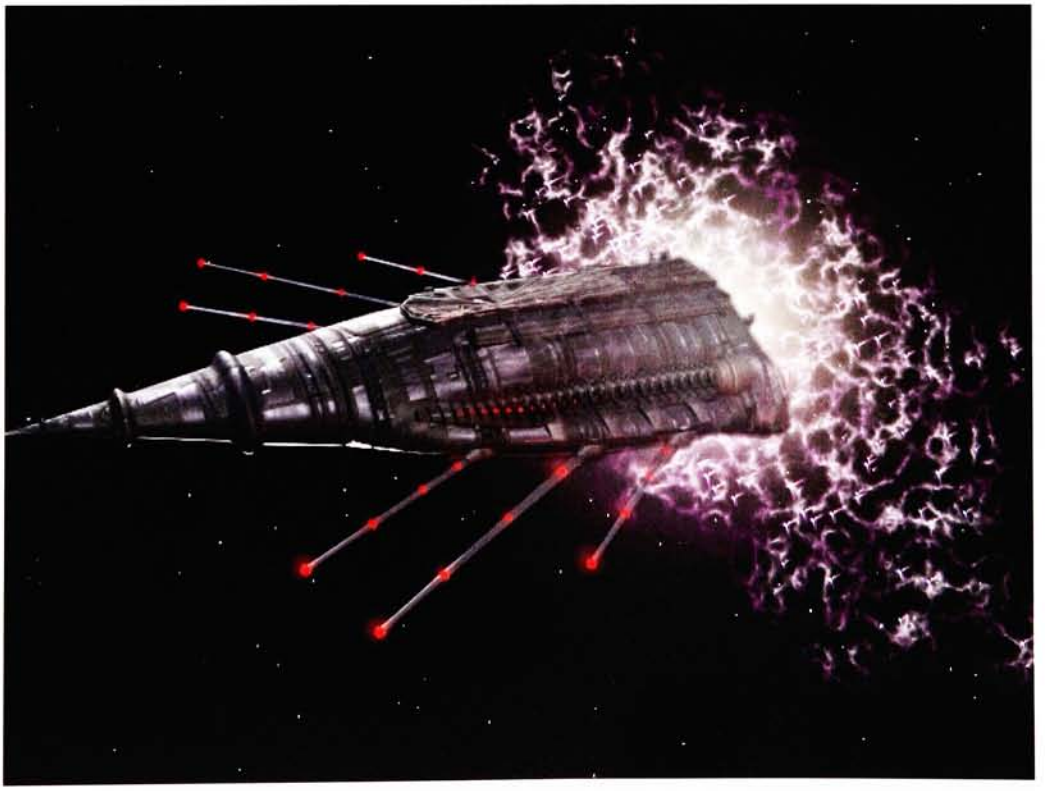

PLANT GROWS

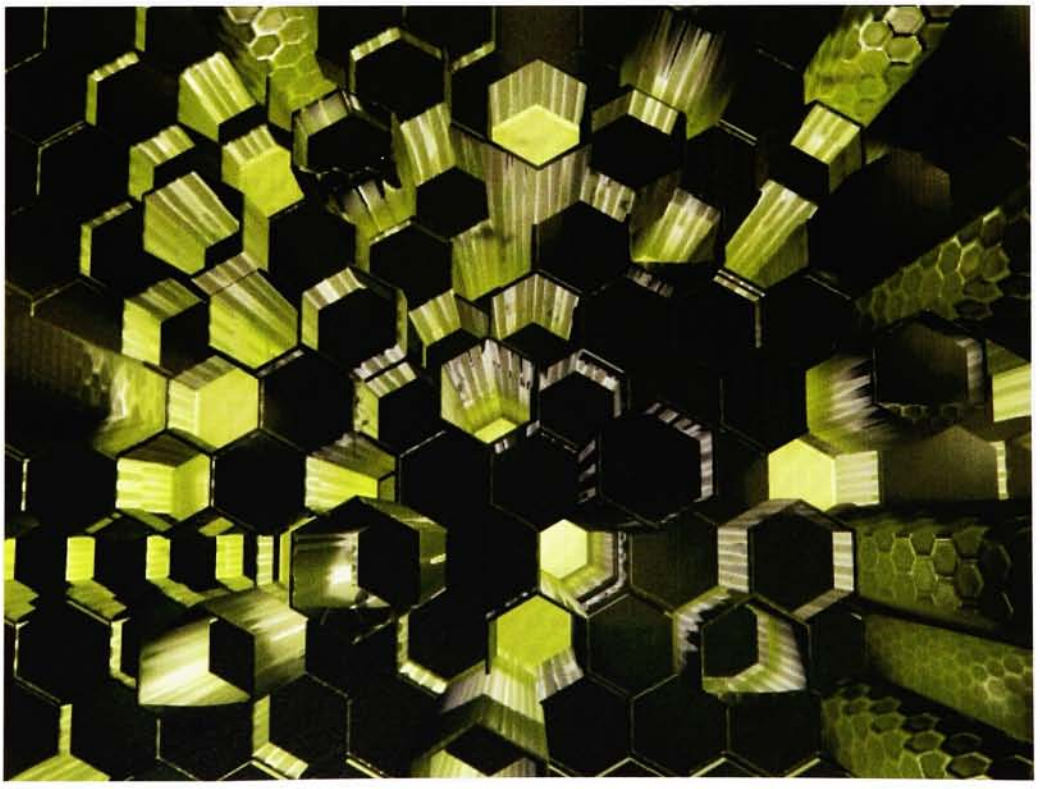

GIANT PLANT SPITS SEED INTO OUTERSPACE


PURPLE
WAVE of odd Purple Color WASHES OVER THE

Appendix C: Color Stills







Appendix D: Technical Notes

Technical Notes

Software:

Programs Used

3D Studio Max V 3 and 4

Plug-Ins (are add on programs which increase the power of 3D Max)

Shag Hair	for fur, and grass
Afterburn	for smoke and fire effects
Quick Dirt	Excellent masking for dirt and other nice texture effects
Particle Studio	Extends normal particle power by giving fuller control over the particles and how they interact with each other. Also has a nice flocking behavior and object assembly-reassemble by particles.
DarkTree Textures	Code objects which can be strung together to make procedural textures.
L-System Plug-In	Made by Blur Studios I wrote L-system code to generate the plant, root systems DNA and part of the intro titles. For more on L-Systems see below.

Additional Programs:

After Effects 4	For compositing, masking and color correction
Photoshop 6.0	Texture creation
Premier	Synch sound, editing. Output to video.
Rhino 1.1	Used to build a few NURBS models. Most of the models were made in 3D Max

Andy	An program for numbering and adding / removing the PC file extensions so they would import correctly into the AVID
Sound Forge and Sound Edit 16	For sound FX editing.

Hardware:

I did this piece on my own computer (including rendering) which is a dual Pentium III 500 MHZ, with 384 MB of RAM, an ELSA made Gloria II 64MB Graphics card and has a 9GB SCSI 10K/Sec Hard drive, and a 4X CDR. I upgraded my computer with a Pinnacle 550DV Pro card and an external Firewire 80GB hard drive so I could go out to video and do synch sound on my own system.

Technical Commentary

In this film my technical focus and hurdles were many. I will share some of my notes and observations on how I did completed the project by dividing the topics into the key technical areas: particle effects, textures, L-System construction, compositing, lighting, and modeling and of course animation.

Particle Smoke and cloud fx:

Many of these were done with the excellent 3D Max plug-in Afterburn.

Smoke and dust as it is stirred up, and as time passes expands (the size of the particle) and thins (the density of the particle), also an increase in the noise seems effective.

Mothership Opens Launch Doors Shot: I stretched the particles for the initial release of gas to make them look like they were escaping from a small aperture, then over time had them resume "cloud" shape and increased noise, and size and animated the cloud phase while decreasing density.

Probe flies through Cloud Shot

I had a localized wind sphere parented to the probe with a negative setting so that it would upset the clouds. In the start of the fly over this works just fine. However, after the probe flies over the clouds, the clouds rebound back to their real state, versus dispersing or breaking apart. I fixed this by adding additional clouds that appear to tear off of the original cloud.

Pollen Spores Shot:

I used Afterburn to also create the Pollen spores by having afterburn render the particles as solids and apply my texture like a displacement map. I used an anti-collide algorithm included in Particle studio for this scene as well as standard collision detection with low bounce and high friction settings, so when the particles struck the robot they would slightly bounce, but mainly stick.

Textures:

I constructed both procedural (mathematically generated) and raster based textures (from scanned photos and drawings).

Heuristics: For bump maps that were close-up or had lots of detail it was important to turn up the blur settings from the default of 1.0 to 1.5 or 2 to avoid "jaggies" (the visible signs of pixels where anti-aliasing doesn't cut it, blurring fixes this problem).
For scenes where there were objects which were shot at close camera distances I often made sure these textures were procedural, so I didn't have to worry about creating giant texture maps, or worry about rasterization. Not only writing the L-systems was a challenge, but mapping them correctly was almost as tricky. Part of the reason was because how I wrote the L-System for the leaves made half of the leaf's Normals to be flipped opposite of the other. I went in and fixed this with the edit mesh function. I mapped most of the flower with "face" mapping - meaning each face of geometry was mapped to. This was an efficient way and worked well for when the geometry grew or changed because the map wouldn't stretch out of shape.

Construction of objects:

L - System Notes:

What are L systems? Previous work using Houdini making a plant with L-systems gave me the necessary experience to work with L-Systems for my thesis. Blur Studios wrote a free L-System plug-in that I used for 3D Max. The idea of the L-System is to create a starting point that declares a set of rules. The rules create geometry. The rules are then run (in the case of growing a flower animated) through generations to create the final effects. There were several resources that I used to help me learn some of the rules-of-thumb when writing scripts for L-systems, they are listed in my bibliography under web-resources.

Lighting:

Lighting is still one of the great limitations in 3D. Radiosity solutions, caustics, and Ray tracing come at great costs in rendering times (if even available). I had a few problems with lighting and shadow flicker. Because of the varying size of my 3D models the flicker was caused by the lighting resolution. Once the shadow maps were turned-up this fixed the problem, and gave me at times almost ray traced looking shadows.

Render Checklist:

- Toggles: (Make sure anything that I may have turned off to increase speed on test renders is on)

- Reflections: Is there raytracing, if so turn it on. Are all the settings set to optimize speed of the render (high quality anti-aliasing isn't necessary for long distance of blurry reflections).
- Glows: Are they turned on? Do a test render at the resolution that I will be rendering.
- Blurs
- Hair: Is the hair render turned on? Does a dynamics solution need to be calculated? To save on rendering times, can I turn down the quality of the hair settings on far away shots.
- Do a 320 X 240 wire render a few times to double check the motion. Then do a full (or near full) test render at 320 X 240 to check to make sure the geometry is working correctly (especially for bound skeletons) and to make sure the isn't any geometry that cuts though other geometry. Look at objects to make sure textures files (not procedurally based) are large enough so that they don't pixilate when the camera comes close.

- Does the background need to be blurred?

- Before final render: Ask yourself, how is the shot continuity. Could the camera position be changed to increase communication between shots? How do the TV safe fields look? Are they cropping too much of the rendered picture?

- Post render – did some of the cuts create bad frames that need to be taken out?

Render Times:

On my machine my rendered times per frame varied from the max of about 3 Minutes per frame on close-ups of the flower which had NURBS petals to 40 seconds per frame on some of the interior shots withing the space-ship. To help with render times I did much compositing of background elements. This saved much rendering time.

SCREENING POSTER (COPY)